

## Effect of chip load and spindle speed on cutting force of Hastelloy X

### ABSTRACT

Research on cutting force revealed that the cutting force decreases as cutting speed increases, which is in line with Salomon's Theory. However, the fundamental behaviour was never clearly explained because most studies had focused on increasing the cutting speed by increasing spindle speed without retaining the rate of chip load. On that note, the effect of increasing spindle speed while chip load is constant on the cutting force of Hastelloy X is presented in this paper. Third Wave AdvantEdge software was applied and half-immersion up-milling simulations were conducted in dry condition. Result showed that the resultant force was primarily affected by the axial force, followed by normal force and feed force. Trend-lines indicated that the behaviour of cutting force components and resultant force was quadratic. Desirability Function Analysis (DFA) results revealed that the optimum combination of chip load and spindle speed led to lowest cutting force components and resultant force was at 0.013 mm/tooth and 24,100 RPM. Furthermore, the optimum cutting conditions that led to the lowest cutting force components and resultant force at chip loads of 0.016 mm/tooth and 0.019 mm/tooth was 24,100 RPM also. Therefore, increasing Material Removal Rate (MRR) while minimizing cutting force components and resultant force can be achieved by increasing the amount of chip load at spindle speed of 24,100 RPM.

**Keyword:** Chip load; Spindle speed; Cutting force; Hastelloy X; Half-immersion up-milling